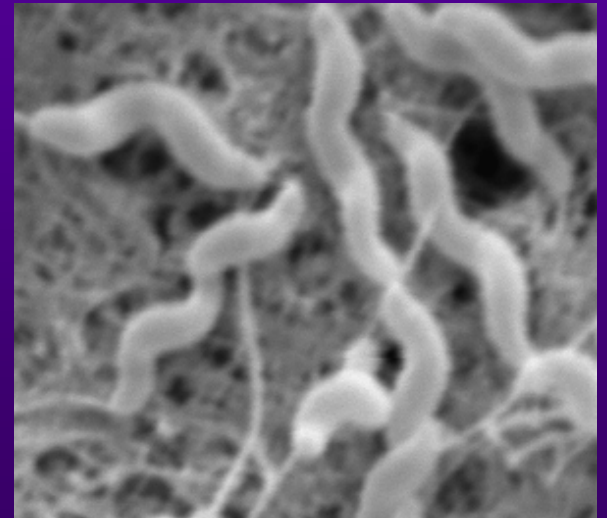


Fluoroquinolone-resistant *Campylobacter* in poultry

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Epidemiological features of *Campylobacter* in poultry

- ◆ G-; spiral shape; enteric organism; significant foodborne pathogen
- ◆ Highly prevalent in poultry, especially in market-age broiler chickens
- ◆ Flock infection typically occurs in the third or fourth week of a production period; *Campylobacter* is not detected in young chickens (<3 weeks old).
- ◆ High pathogen load in the gut, leading to extensive contamination of carcasses in processing plants
- ◆ increasingly resistant to the antimicrobials including fluoroquinolones (FQ), tetracycline, and macrolides.

Long-term Goals

- ◆ Understand the risk factors influencing the development and persistence of antibiotic resistant *Campylobacter*
- ◆ Design measures to prevent the spread of antibiotic resistant pathogens.

Specific questions to be addressed

- ◆ Is there a difference between organic operations and conventional production in terms of antibiotic resistance?
- ◆ Does antibiotic treatment of chickens directly promote the occurrence of drug-resistant *Campylobacter*?

On-farm Survey

- ◆ 10 integrated conventional broiler operations; 10 integrated conventional turkey operations; 5 organic broiler farms; and 5 organic turkey farms.
- ◆ At least 30 intestines from each conventional poultry farm and approximately 60 intestines from each organic poultry farm.
- ◆ Totally 1290 intestinal tracts collected
- ◆ Each intestine aseptically opened and cecal content cultured for *Campylobacter* (direct plating).
- ◆ 1044 *Campylobacter* isolates obtained.
- ◆ 694 tested for antimicrobial susceptibility
- ◆ Agar dilution method

Campylobacter Prevalence Data

Production type	No. positive (%) / No. Sampled	No. (%) positive for	
		<i>C. jejuni</i>	<i>C. coli</i>
Conventional broiler farm	227 (65.80)/345	220 (96.92) ^a	7 (3.08) ^b
Conventional turkey farm	299 (83.06)/360	137 (45.82)	162 (54.18)
Organic broiler farm	317 (89.30)/355	229 (72.24)	88 (27.76)
Organic turkey farm	201 (87.39)/230	133 (66.17)	68 (33.83)

Resistance rates: conventional vs. organic

Antimicrobial agents	No. (%) resistant <i>Campylobacter</i> isolates			
	<i>C. jejuni</i>		<i>C. coli</i>	
	Conventional (n=240)	Organic (n=211)	Conventional (n=128)	Organic (n=115)
Ampicillin	30 (12.5) ^a	11 (4.58) ^b	33 (25.78) ^c	4 (3.49) ^b
Tetracycline	213 (88.75) ^a	110 (52.13) ^b	114 (89.06) ^a	70 (60.87) ^b
Gentamicin	0	0	0	0
Kanamycin	63 (26.25) ^a	29 (13.74) ^b	109 (85.16) ^c	49 (42.61) ^d
Clindamycin	37 (15.42) ^a	5 (2.37) ^b	93 (72.66) ^c	9 (7.83) ^a
Erythromycin	46 (19.17) ^a	5 (2.37) ^b	114 (89.06) ^c	15 (13.04) ^a
Ciprofloxacin	128 (53.33) ^a	2 (0.95) ^b	84 (65.63) ^c	1 (0.87) ^b
Norfloxacin	129 (53.75) ^a	2 (0.95) ^b	82 (64.06) ^c	1 (0.87) ^b
Nalidixic acid	130 (54.17) ^a	2 (0.95) ^b	82 (64.06) ^c	1 (0.87) ^b

Resistance rates on different types of farms

Antimicrobial agents	No. (%) resistant strains isolated from			
	Conventional broiler farms (n=167)	Organic broiler farms (n=165)	Conventional turkey farms (n=201)	Organic turkey farms (n=161)
Ampicillin	0 ^{a*}	5 (3.03) ^a	63 (31.34) ^b	10 (6.21) ^a
Tetracycline	141 (84.43) ^a	99 (60) ^b	186 (92.54) ^c	81 (50.31) ^b
Gentamicin	0	0	0	0
Kanamycin	19 (11.38) ^a	28 (16.97) ^a	153 (76.12) ^b	50 (31.06) ^c
Clindamycin	2 (1.20) ^a	9 (5.45) ^a	129 (64.18) ^b	5 (3.11) ^a
Erythromycin	0 ^a	15 (9.09) ^b	160 (79.60) ^c	5 (3.11) ^d
Ciprofloxacin	76 (45.51) ^a	0 ^b	136 (67.66) ^c	3 (1.86) ^b
Norfloxacin	77 (46.11) ^a	0 ^b	134 (66.67) ^c	3 (1.86) ^b
Nalidixic acid	77 (46.11) ^a	0 ^b	135 (67.16) ^c	3 (1.86) ^b

Multidrug Resistance Rate*

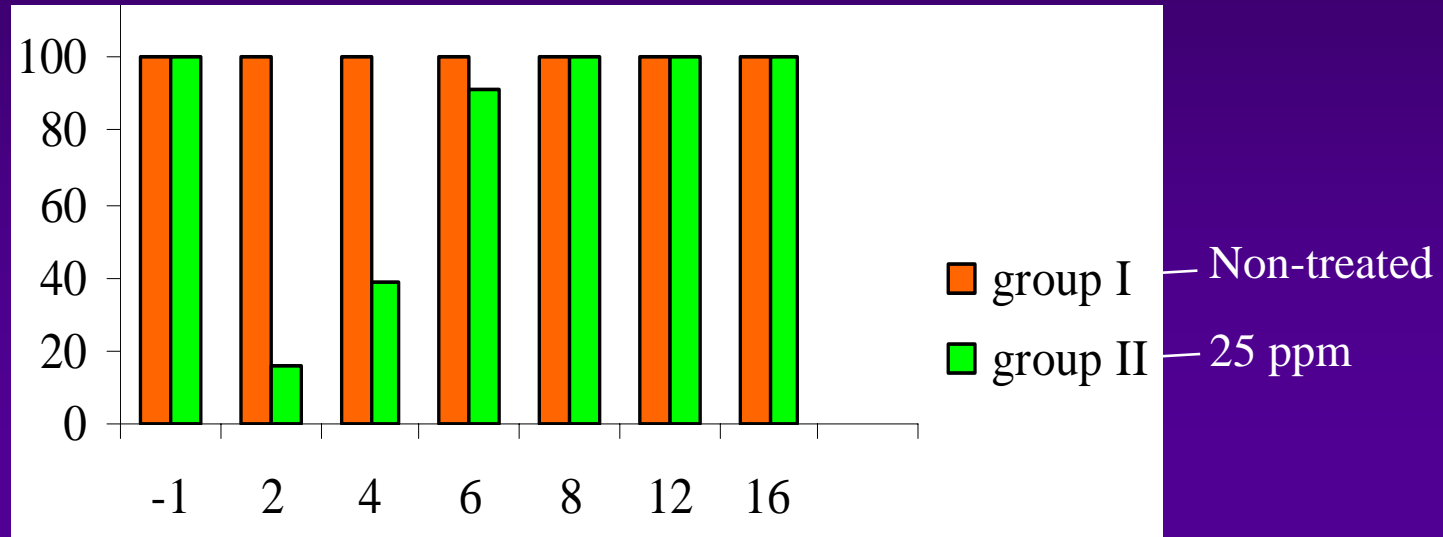
Operation types	No. (%) multidrug-resistant strains
Conventional broiler (n=167)	15 (8.98)
Organic broiler (n=165)	11 (6.67)
Conventional turkey (n=201)	163 (81.09)
Organic turkey (n=161)	8 (4.97)

*Resistance to 3 or more classes of antimicrobials

Effect of FQ treatment on colonization

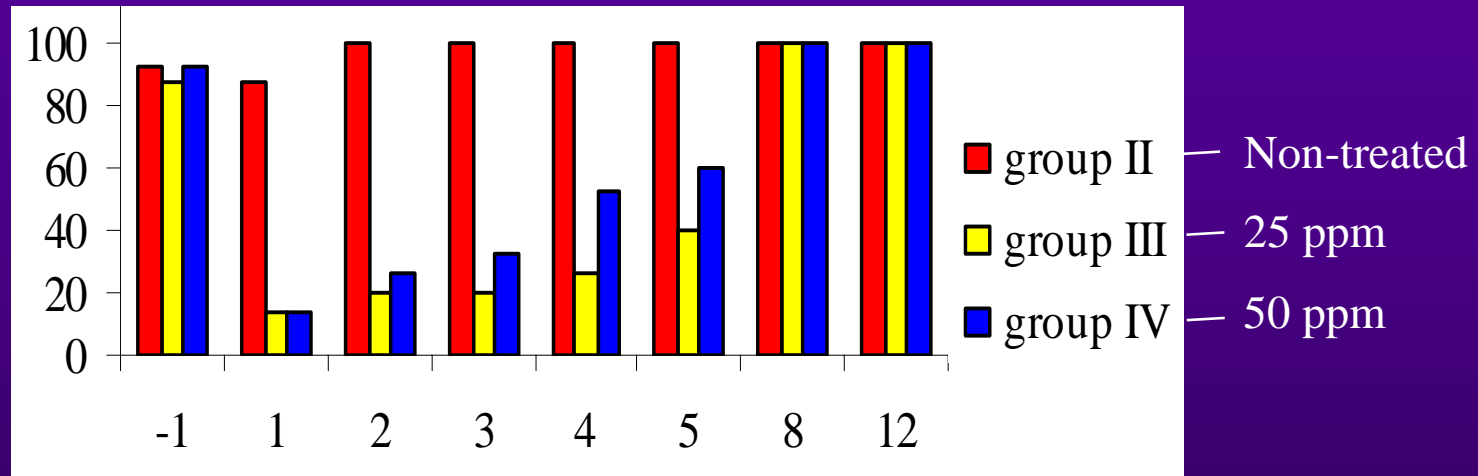
Exp. I

% chicken colonized



Exp. II

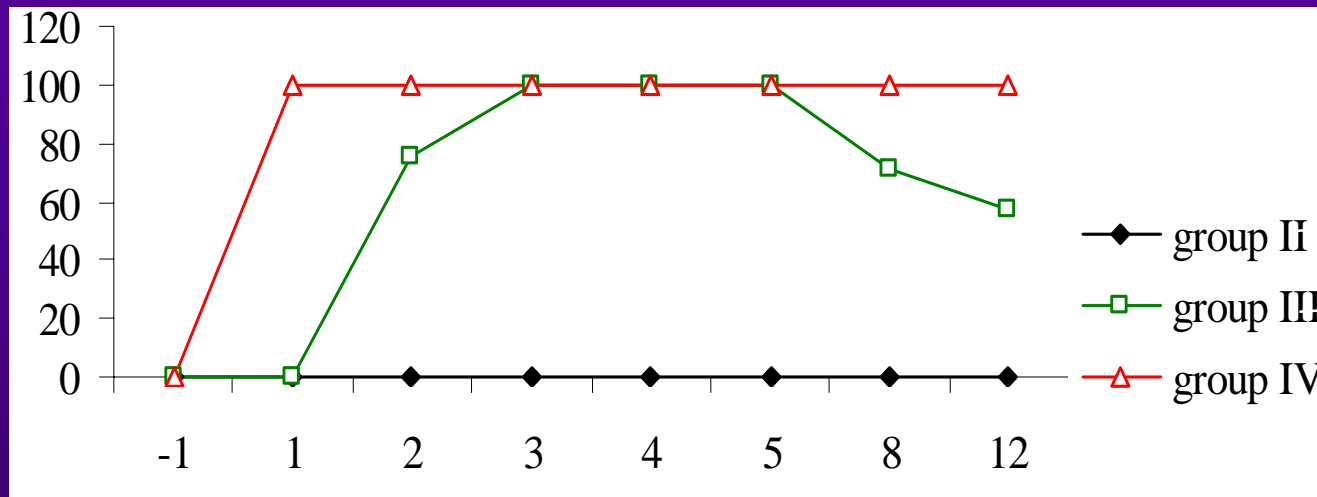
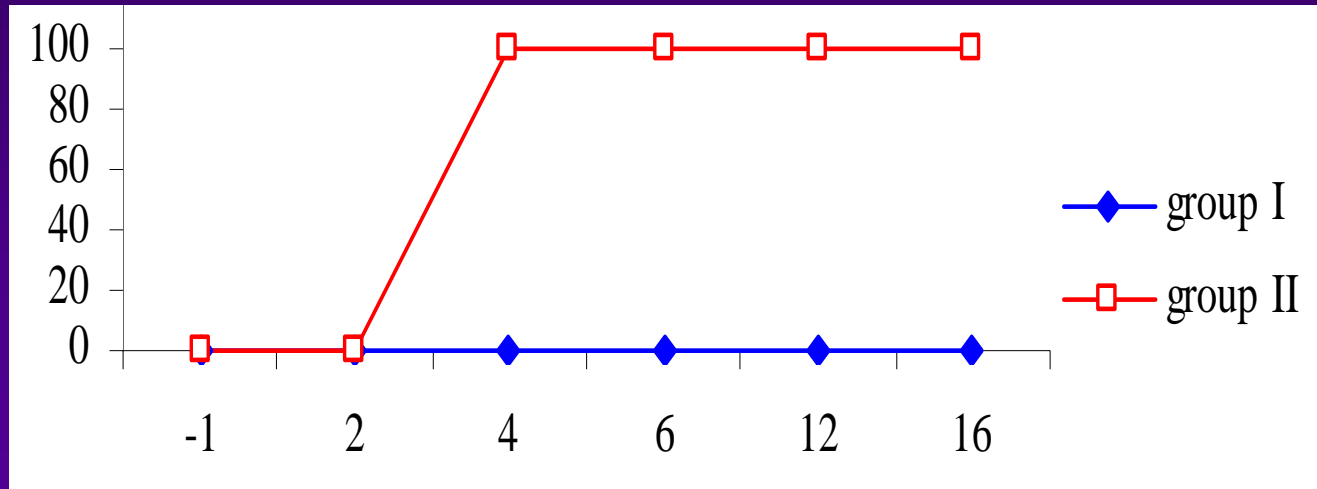
% chicken colonized



Days after the initiation of treatment

FQ-resistance rate before and after treatment

% FQ-resistant isolates



Days after the initiation of treatment

FQ Resistance level (MIC) before and after treatment

Before

0.125 $\mu\text{g/ml}$

No resistance—associated mutations in DNA gyrase

After

>32 $\mu\text{g/ml}$

All carry the resistance—associated mutation in DNA gyrase

Summary

- Conventional farms harbor more antibiotic resistant *Campylobacter* than organic operations
- Turkey farms have more antibiotic resistant *Campylobacter* than broiler farms
- FQ-treatment directly promote the emergence of FQ-resistant *Campylobacter* in chickens
- FQ-resistant *Campylobacter* continues to persist in chicken flocks in the absence of selection pressure.

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